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$$AN = AM \cos \beta = r \cos \beta - a \sin \beta.$$

$$\text{Volume of } ADEG = 2\pi ar^2.$$

$$\text{Volume of } EGF = 2 \int_0^{2r} \int_0^{\sqrt{(2rx-x^2)}} \int_0^{x \tan \beta} dx dy dz = \pi r^3 \tan \beta.$$

[This result comes easily without the calculus].

Substituting in equation (1), transposing, dividing through by $\cos \beta$, rearranging, and clearing of fractions,

$$5r^2 \tan^3 \beta + 16a \tan^2 \beta + 2(8a^2 - 3r^2) \tan \beta - 16ar = 0.$$

Substituting in this, $\frac{1}{2}h - rt \tan \beta$ for a , and reducing,

$$5r^2 \tan^3 \beta - 8r \tan^2 \beta + 2(5r^2 + 2h^2) \tan \beta - 8rh = 0,$$

from which β may be found.

AVERAGE AND PROBABILITY.

62. Proposed by O. S. KIBLER, Superintendent of Schools, Middleburg, O.

A bag contains any number of balls, which are equally likely to be white or black; one is drawn and found to be white. Show that the chance of drawing another white one, the first ball not being replaced, is two-thirds. [From *C. Smith's Treatise on Algebra*, page 615].

Solution by G. B. M. ZERE, A. M., Ph. D., Professor of Science, Chester High School, Chester, Pa.

If m balls are drawn and turn out white, the chance that n others drawn will be white is: $p = [(m+1)/(m+n+1)]$. In the problem, $m=n=1$.

$$\therefore p = \frac{2}{3}. \text{ Otherwise, } p = \int_0^1 x^2 dx / \int_0^1 x dx = \frac{2}{3}.$$

This is the simplest case of the article on page 107, No. 4, Vol. II. of the MONTHLY.

64. Proposed by REV. W. A. WHITWORTH, A. M.

O is a given point within a triangle; P is a random point within the same. The line through O and P is produced so as to divide the triangle into a trapezium and a triangle. Find the average area of this triangle. [From the *Educational Times*, London, Eng.]

Solution by G. B. M. ZERE, A. M., Ph. D., Professor of Science, Chester High School, Chester, Pa.

Let Δ be the average area required, Δ_1 the average area of BFG ; (m, n) coördinates of O . Then the coördinates of E are $(b, bn/m)$; of D , $[b^2 n / (ab - am + bn), abn / (ab - am + bn)]$.

$$\text{Area } ABC = \frac{1}{2}abs \sin C.$$

$$\text{Area } ACO = \frac{1}{2}bns \sin C.$$

$$\text{Area } ADO = bn(am - bn) \sin C / [2(ab - am + bn)].$$

$$\text{Area } COE = bn(b - m) \sin C / (2m).$$

$$\text{Area } DOEB = ABC - (ACO + ADO + COE).$$